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A STUDY OF AMERICAN COLLEGES OF AGRICULTURE: PROGRESS REPORT

An address by Charles E. Kellogg, Director, A Study of American Colleges of Agriculture, University of Maryland, before the Association of State Universities and Land-Grant Colleges, Chicago, Illinois, November 11-13, 1963.

WE CAN GIVE ONLY A PROGRESS REPORT at this point, which is about one-third along in our schedule for the Study. That is, we hope to conclude sometime in 1965. We do not plan any extensive exhibit of statistical data from either published sources or new questionnaires. We are mainly concerned with issues, policies, and directions in teaching, research, and extension. Most of our ideas will be drawn from effective old and new programs within the colleges themselves. Parenthetically, I should like to emphasize our great appreciation of the cooperation, council, and courtesy we are receiving from the leaders and staff of the colleges of agriculture.

We have developed a group of ideas and working hypotheses from our work so far. The validity of these we are seeking to test through visits to several of the land-grant colleges and universities, by field studies among farmers, and from discussions with a wide variety of people concerned with agriculture and with higher education.

Our principal concern is with defining the function and purposes of colleges of agriculture within the land-grant universities, with special focus on the area where the teach-

ing, extension, and research merge together. This feature of the agricultural colleges in the land-grant universities is nearly unique in the world. Many assert that this feature is a basic source of strength to American agriculture. Functional definition is critical now since both the agriculture that the colleges have served and the universities of which they are a part have changed radically during the last two decades. We hope to understand how the changes in agriculture and in higher education generally have affected the colleges and how the colleges should plan to adjust to even more radical changes in the future.

During our work, we are continually impressed by the wide diversity among our colleges of agriculture. We regard diversity as both inevitable and desirable, since each college has its own state problems to meet. No two states are alike. Each has its own special environment and academic traditions. Some states have no other full universities; others have several.

In our Study, we are concerned with one basic uniformity: That each college find ways, including field studies, to determine the needs it should meet in research, teaching, and extension; to appraise its probable facilities; and to achieve a high level of excellence in the work that it does undertake.

Thus we are less concerned with criticism of what <u>is being done</u> by the colleges than with projections of what <u>should be done</u>. Naturally, it is necessary to have an understanding

of the existing programs in teaching, research, and extension in order to project for the future. We are especially interested in seeing how the colleges have evaluated their own programs, have adjusted in recent years, and how these adjustments are now being used as the basis for making judgments about the future. For example, not all colleges of agriculture can hope to have the staff and facilities for research in depth and for graduate study in many fields. Yet they can have other research of great importance within the state and first-class undergraduate programs.

We can all find within the colleges a wide variety of programs and of changes that reflect the direction of our own present thinking. Several colleges have made fundamental changes in their curricula and in the objectives they are seeking in modern undergraduate education. In many curricula the required basic courses are increased and the number of fields in which applied courses are required has been reduced. Several have excellent programs shorter than 4 years for potential farm managers and agricultural technicians; others do not.

Despite the progress made, the objectives of curriculum building and the standards for a B.S. degree appear to need clearer definition. Many colleges now offer students solid curricula of the basic courses in mathematics, science, language, and the humanities that lead to professional careers in science and in the management of agriculturally oriented

businesses. How can more students be motivated in these directions? Several colleges are assisting high school teachers with facts about such careers. Yet other offerings for the same degree are weak in the basic sciences.

Although farming is not all of agriculture, it is a part of it. Our preliminary studies tend to confirm the assertion by many people that far too few of the young men who are to manage commercial farms are among those now graduating from either the 4-year or shorter curricula of the colleges of agriculture. All of us here would probably agree that managers of good commercial farms would benefit by higher education, especially that basic to changing farm practices and management. Each state can have programs of different kinds and different lengths to meet the needs of prospective farmers. And the prospective farm managers need to know about them. Although degree programs are quite different from shorter programs, each can have its own high standards of excellence.

We can also identify important modifications in research and extension programs, although these are somewhat less obvious than the changes in the curricula.

For planning extension and research within the college account must be taken of the probable effects of other state and national programs. Since the middle 1930's, for example, the Department of Agriculture was directed to initiate several programs that required direct working arrangements with

farmers. This called for adjustments within extension programs which have been made in ways that show that extension people can make adjustments and enhance their service to rural people.

Beginning especially after the Second World War, the federal government has had large resources--that is, large in relation to the research grants to the agricultural colleges--for so-called project-type research grants. Whereas the Hatch Act has had two highly important purposes and results--one to help initiate and to maintain at least one high quality research staff in each state, and another to obtain research results of great importance to economic growth--most project-type grants have only the one primary purpose of getting specific research results. These grants can be used to strengthen the research activities of the college of agriculture and to develop better balance; they can also result in further unbalance of staff and activities in relation to the needs of the state.

Although most agricultural scientists in both the Department and the land-grant universities have thought of their work in terms of benefit to all citizens, perhaps they have seemed to be more especially conscious of their farm clientele. Now there may be a growing awareness of service requirements for the non-farm part of our population. Just as one example, many non-farm people living in the urban fringe have problems to which the principles developed through research in the agricultural colleges apply directly. Some have seen these problems

more clearly than others and have taken responsibility to help solve them.

Some of the most critical questions that have to be raised in a study of this kind deal with the relationships of the colleges of agriculture to other parts of the educational system and to society as a whole. Thus, important questions that appear to have obvious answers to people within colleges of agriculture require systematic explanation and presentation to a considerably wider public. For example, some members of our Advisory Board have emphasized that it seems essential to define "agriculture" before we can be in a position to suggest whether or not agricultural education is progressing satisfactorily.

In the beginning perhaps many did assume that teaching, research, and extension in agriculture meant the application of the sciences, especially the natural sciences, to the problems of farming. In fact, to many the words "farming" and "agriculture" were essentially synonymous. Certainly, this has not been true for a long time. As agriculture has become more technical, we have seen the trends toward fewer workers on farms and more workers in the off-farm sector of agriculture. Between 1935 and 1962, our total farm population changed from roughly 32 million to around 14 million. Last year the total number of workers on farms was about 6.7 million. Now, we all know that many of the "hoe hands" that came out of cotton fields,

corn fields, and sugarbeet fields, statistically speaking, went to cities and towns to manufacture the production materials that farmers need and to process their products by modern engineering methods. In 1962 it has been estimated that these workers amounted to around 16 million people, or about two and one-half times the number of workers resident on farms. Thus, if we take the total workers in agriculture, in both the public and private sector, we find somewhere between 22 and 23 million. And if we add their families, this would give a total of nearly 50 million people, which is a substantial part of the total population.

But apart from this, people in professional agriculture for many years have been deeply concerned to have an agriculture that furnishes, on a sustained basis, good quality food and fiber to all citizens at reasonable cost. They have been enormously successful--more so than in any other country in world history.

I know this is all familiar to you, more so than to other people. I emphasize it because I think we have all been trying too hard to separate out those fields that are "agricultural" from those that are "not agricultural." One cannot classify either segments of knowledge or broad economic and social problems in this way. In fact, most of the broad problems in the United States are contributed to and affected by this broad field of agriculture, as I am now trying to look at it.

I am again reminded of the diversity among colleges of agriculture. In some we find the "hard core" agricultural departments of animal science, plant science, and soil science, plus botany, zoology, biochemistry, agricultural engineering, and so on. In another agricultural college, several of these departments are attached to other colleges for convenience of administration. We certainly cannot say that these departments or scientific fields are "agricultural" in one place simply because they are in the college of agriculture and "non-agricultural" in another place because they are administered in other colleges. By tradition neither law nor political science, so far as I know,have been housed in a college of agriculture. But both are very important in agriculture. And if the staffs within the departments that are in the colleges of agriculture are working at their full professional level, they have many contributions to make to problems and programs mainly outside of agriculture.

Although we have not thought this all the way through, it seems nearly obvious that the leaders within the colleges of agriculture have responsibilities in education, research and extension far beyond the subjects represented by those departments that are placed within the college of agriculture for administration.

Not only do colleges have different departments within them, but also we should expect the departments in contrasting

states to have somewhat different orientations.

We can agree, perhaps, that colleges of agriculture must be primarily concerned with ideas and their application through education, research, and extension for an agriculture that fairly rewards its participants, gives efficient service to its customers, and contributes to the general economic and cultural growth of the country. Even with agreement on basic principles, we must expect several satisfactory schemes of organization toward that end within the 50 states.

SOIL SURVEY, AGRICULTURE, AND ECONOMIC DEVELOPMENT

Charles E. Kellogg

I should like to talk with you briefly about the place of agriculture in economic development and some of the current problems on which the Soil Survey will have opportunities for usefulness.

Every advanced country in the world without exception got its start toward economic and industrial development from agriculture, along with fishing and forestry. This principle is now fairly well understood and accepted. That an efficient agriculture is also essential to sustain economic development is not so widely appreciated.

In their concern about economics, people may overlook that in a society so complex as ours all of the things we have result from labor applied to natural resources. At the beginning of this century about one-third of our working people were engaged in farming, fishing, and forestry; about one-third in mining and manufacturing and about one-third in services--school teachers, government workers, barbers, and all the rest. The fraction for manufacturing has not changed, but that for farming, fishing and forestry has greatly declined and the proportion in services is now well over one-half. Still city people cannot get wealthy simply by trading vests with one another.

American Farming to 1930

Since the middle of the 19th century and especially since 1900, American agriculture has changed faster than most of us realize, even faster than many of us in agriculture appreciate. Formerly the words "agriculture" and "farming" were used nearly synonymously. This is no longer possible without great confusion. Somewhat less than one-third of the people now employed in agriculture actually work on farms. The figure for farm workers is about six million, including family labor. Another six million manufacture machines, chemicals, and the like for farmers to use in production. Then about eleven million are engaged in processing farm products. Thus a great deal that was formerly done on farms is now done in the city. Statistically, many agricultural workers have moved from farms to the cities as agriculture has become more industrialized and urbanized. In addition, other workers in steel, automobiles, transport, and other services also contribute to agriculture as well as to other segments of economy.

In the United States, early agriculture was not only synonymous with farming but it was once primarily mixed farming. Most early farmers produced many kinds of fruits, vegetables, grains, and animals. As farmers moved West where the alternatives were fewer, they specialized in grain. Others had specialized in rice and tobacco fairly early.

We might look briefly at the period from 1900 to 1914. Although some farmers specialized, most of our farms were mixed ones with a high level of subsistence.

* Opening remarks at the National Technical Work-Planning Conference of The Cooperative Soil Survey, Chicago, Illinois, January 25-29, 1965.

Taxes were low. Most of the power was raised as hay and oats while now it is supplied by the oil and electric companies. Farming was spread over a very large area that included much land with poor soils. Homesteading came to an end almost with a bang in 1910. The land-use adjustment that started around 1912, and that should have continued, was interrupted by World War I.

This period of 1900 to 1914 was really a great one for American farmers. They had "parity" but did not know it. Even the word yet had to be coined. The United States owed Europe money and these loans were serviced with farm exports. There were many alternative opportunities in the towns and cities for farm boys and girls. It was just before the War that farmers started voting taxes on themselves for assessment--district roads and bought automobiles. Soon many were buying tractors. Their taxes increased and their expenses increased.

Instead of having a continuation of the adjustment to take poor soils out of use, the very high prices from 1914 to 1919 made it possible for poor farmers on poor soils to keep going. At the beginning of that War rural people accounted for more than one-half of the total population; at the end of it over one-half of our population lived in the cities. Urbanization has kept going since that time.

When the First World War was over, the United States was a creditor nation. Europe owed us money. Europeans were unable to buy our farm products as they had before. U.S. farming was greatly depressed. Yet the cities--city industries and services--seemed to be going strong, with personal war-time savings and credit. The stock markets were booming. Some far-seeing people were worried about the consequences of a depressed agriculture but bills passed by the Congress to bring about orderly marketing of farm products were vetoed.

Then came the crash in 1929. It took this terrible bang to get some people to realize the importance of agriculture in sustaining economic growth as well as for initiating it. One wonders if we shall all need to relearn the same lesson?

USDA and Land-Grant Colleges of Agriculture

I should like to go back now and say a word about the institutions we know so well--the USDA and the land-grant colleges. (1) Both were organized during the War between the States. There was no great public clamor for either. They came into being because of the great vision of a few far-seeing people.

The USDA developed into a kind of national university. It was concerned mainly with research and exploration and the use of the results to help farmers and others concerned with agriculture to adopt better practices, to improve their lives, and to insure consumers food and fiber of dependable quality at reasonable prices. People in the USDA and the colleges had a great deal in common. They worked together. In 1887 the then Commissioner of Agriculture invited the agricultural colleges to meet in Washington in order to discuss a plan for a permanent organization. This was just after the Hatch Act granting research funds to the colleges had passed. They did organize under the name "Association of American Colleges of Agriculture and State Experiment Stations."1/ The

1/ After several changes in name, the organization is now called the "National Association of State Universities and Land-Grant Colleges."

Department itself nursed this little association for many years. Its annual reports, beginning with 1888, were published as bulletins of the Department of Agriculture through 1909. Dr. A. C. True of the Office of Experiment Stations worked closely with the leaders. Together with them he organized a series of summer graduate schools, which were held every other year on various campuses from 1902 through 1916. Faculties were drawn partly from the Department, but mainly from the colleges. Five years after the last one of these, in 1921, the present Graduate School in the USDA was established.

Far more important than these efforts at graduate training were the scholarly seminars characteristic of the Department during its first 75 years. Many of these were organized by research scientists within the USDA; others also included scientists from the Smithsonian Institution, the U. S. Geological Survey, and the National Bureau of Standards.

Then about 1911 or so a note of disharmony arose. Both the Department and the colleges had been doing what we now call "extension." I suppose that by 1912 the Department had more such agents in the southern States than the colleges. The presidents of the colleges liked the idea of extension but they did not know quite how to organize it. Yet they trusted Secretary of Agriculture Houston. Finally agreement was reached that this work would be cooperative and that the direct relations with farm families would be handled by the colleges. Thus was born the Smith-Lever Act of 1914 under which we have now what we call "cooperative extension." This seemed to settle the question of jurisdiction. The direct relations with farmers would be handled by the colleges.

Then in the early thirties came the New Deal. The country faced a deep crisis and all sorts of programs were initiated to reduce distress and to get agriculture again performing its traditional role in economic development. At the very start, the New Deal did use the extension agents, but after a little while many of its bureaus were dealing directly with farmers. Again there arose tension. But extension is a fairly adaptable organization and has found its role. At least under the usually good conditions, the county agent is the informal "chairman of the board" who helps in the coordination of both State and Federal programs in terms of needs within the county.

The USDA changed greatly. Although Henry Wallace and M. L. Wilson presided over a great seminar period--a program any university would have been proud of--Wallace also presided over the change of USDA from a national university to the arm of the Federal government for agricultural policy. Even though agricultural research actually increased, this kind of intellectual effort had little to do with the atmosphere of decision in the Department after the Second World War.

Interdisciplinary Research and Extension

Another great change came about 1939. Although the best agricultural scientists had long been aware of the importance of interdisciplinary research and application earlier, it had an amazing new emphasis during the early 1940's. It was not

the dramatic single improvements that gave the great increases in farm production and efficiency, but the combinations of practices that captured the benefits of the interactions among practices and between them and the soil. (2)

In an advanced country we are clearly no longer concerned only with what a soil will produce with simple management. The question is, "What can we make of this kind of soil using our machines, chemicals, improved varieties, pest control, and so on?" Some of our most productive soils today were among those rejected for farm use only 30 years ago. Look what has been done, for example, with the soils of Florida. Other soils that were farmed in 1933 have been too unresponsive to continue in use for crops.

Some say that these developments have made the kind of soil less important since many can be brought to the same high level of yields. Nothing could be farther from the truth. The management routes to high yields and similar efficiency on contrasting kinds of soil are very different. A wrong choice can be financially disastrous.

Changes in Commercial Farming

Since the beginning of the Second World War we have seen, therefore, a great substitution of capital, in the form of city-made production goods, and of management skill for both labor and land. For the period 1962-4 had we used the practices of 1939-42, it would have taken 518 million acres of land instead of the 334 million acres we did use to have had the same production, or 55 percent more acres.

This has given high premiums to good management and severe penalties for poor management. Farmers lacking management skill, including both business and technical skill, have been forced out of commercial farming. No activity in the United States is more competitive than commercial farming.

Most commercial farms are now highly specialized. Few have more than three important enterprises; many only one. The managers have learned about their enterprises in far greater depth than formerly. This fact has enormous implications for the colleges, the USDA, and private suppliers of farm production goods.

Actually commercial farms are about as urbanized now as the traditional urban business.

Food Processing

The advances in food processing, which most of us take more or less for granted, have been equally dramatic. They have given consumers much better materials with far less waste and spoilage. How else could we get food to our great population centers?

Remember too, in all of this, the average American uses a smaller percentage of his working time for food than the people of any other country, even counting the cost of farm programs. In fact, one can raise this question about the so-called farm "subsidies": Just who is subsidizing whom?

Land Values

Another great change since 1939 has been the enormous increase in land values. City people have bid up land for living space and recreation. Some have bought land to hedge on inflation and to escape part of their income taxes, especially by changing ordinary income into capital gains. But especially have farmers competed with one another for land to enlarge their units, to use bigger machinery, and to become more efficient.

At current prices, the unit costs of commercial farmers are lower if we do not count increased land values. If we do count them, most have higher unit costs.

New Problems

From the beginning, the agricultural leadership has more or less assumed that if farmers were shown how to handle efficiently their soils, water, plants, and animals, they would be automatically better off. This has not happened that way in rural areas.

It was easier to expand production than to lower it for several reasons. For example, one cannot turn in big machines for little ones.

The technology that helped some farm managers, and especially consumers, threw other rural people out of work at home. Some call this the "backlash" of technology.

Agricultural leadership has not kept up with these rapid changes. The whole agricultural establishment--USDA, agricultural colleges, and farm organizations--appear to others to be conservative, defensive, unimaginative, and quarrelsome. We have not even brought our own language up to date. We say "agriculture" when we mean only "farming," and "agricultural" land when we mean cropland. We still say that one farm worker feeds himself and 34 other people and thus ignore the many other agricultural workers.

What are the main problems in the rural areas?

Education has been seriously lagging behind urban and especially suburban communities for many years, even in "good" farming areas. Compare to suburban areas, schools are poor; emphasis is still given to vocational agriculture for boys who haven't a change to get such work as more than laborers; a smaller percent get to college; and those who do go to college are less well prepared.

What is the agricultural establishment doing about this? Some are doing a little--far too little.

Underemployment is great in rural areas. Probably about 18 percent of nonfarm people have incomes less than $3,000 and about 43 percent of farm families.

Jobs, including jobs in industry, are needed in rural areas.

Public health facilities in rural areas have not kept pace with those in cities.

On these three most basic problems what have the colleges, the USDA, and the farm organizations really done? Not enough, and no one else has taken the leadership. Believe me some group--some different group--must take it if these three do not.

A basic trouble is that many of us in agriculture have not even cared enough to inform ourselves to the point where we can read about and discuss rural problems!

Perhaps even more, so many of us look at these areas to see what our particular department, bureau, or what not can contribute. We cannot tell that until we first identify the problems and potentialities without regard to agency or speciality.

Modern planning requires competent resource examination and economic forecasting.

Now it is possible to forecast population changes, energy requirements, what people will want to use, and so on. For their national planning France is doing an excellent job. (3) So are many large American corporations. All of this is done with mathematics developed since the end of the Second World War.

Within these projections adjustments can be planned. Problems ahead can be anticipated and avoided before they arise.

Geographic areas can be studied and industry planned for by government loans or grants to the private sector to get development going.

Soil Survey

In such work our soil surveys can be enormously important for both general and operational planning. But not soil surveys alone. Knowledge of minerals and water are needed to predict industrial potential. The economics of development is an essential skill. Then too, the design of a useful soil survey, and especially of its interpretations, must be based on a good understanding of the problems--of the problems people really have in rural, urban, and urban-fringe areas.

The soil survey has always needed good soil scientists. It still does, of course, and some of these must read, study, and work with others quite beyond what we've traditionally done. Science and technology are growing at an exponential rate. In each decade our methods change far more than in the previous one. It will take hard study just to stay even.

We cannot expect to be able to train economists and others to use soil surveys without interpretation. This means to me that soil scientists must learn much more about plants, animals, engineering, and economics than we can expect experts in these fields to learn about soils. Unless we prepare ourselves to go a great deal more than half way to cooperate with others, we will not be effective.

(1) Association of American Agricultural Colleges and Experiment Stations. Proceedings of Annual Conventions. 1888-1914.

(2) Kellogg, Charles E.
Interactions in Agricultural Development. In "Science, Technology, and Development," United States papers prepared for the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. (Geneva, 1963) Vol. III. Agriculture, pp. 17-24. Washington 1962.

(3) Bauchet, Pierre
Economic Planning: The French Experience. (Trans. by Daphne Woodward.) 299 pp. Heinemann. London 1964.

RESOURCE USE AND ECONOMIC DEVELOPMENT: THE ROLE OF THE LAND-GRANT UNIVERSITY

An address by Charles E. Kellogg, Deputy Administrator for Soil Survey, Soil Conservation Service, U. S. Department of Agriculture, Washington, D. C., before the Staff of the Minnesota Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota, October 27, 1966.

The great system that we call modern American agriculture has changed enormously since you and I were farm boys. It has become increasingly specialized, technical, and urbanized. Some 35 to 37 percent of the country's labor force work in it. During this change the number of jobs on farms has gone down and the off-farm jobs in agriculture have increased. For every farm worker at least one other worker makes chemicals, machines, and other production goods for him to use. About two and one-half agricultural workers process his products, and still others provide many kinds of essential services.

Despite this change, many still talk about "agricultural land" when they mean "farm land." Others even use the general term "agriculture" when they mean only the farming sector. Such out-of-date language confuses ourselves and especially confuses those outside of agriculture about our programs in research, teaching, and extension.

You in Minnesota and some of your counterparts in other States are beginning to emphasize that we must think of all the resources in the rural areas and of their potential uses, not only for farming but also for forestry, recreation, nonfarm segments of agriculture, housing, and other sectors of our economy.

Only in this way can we help the citizens plan for good living and economic development[1/] so that each segment of the local economy prospers and, in doing so, helps the other segments to prosper. The fact that you are now struggling with problems of technique, of appraisal, and of ways to serve citizens in community planning, pleases me very much. I have seen your Extension bulletin on the Soils of the Twin Cities Metropolitan Area.

Planning Resource Use

The term "planning resource use" includes the decisions required for good living and for effective use of investments in land, labor, and development. Such decisions are based on forecasts of need, including population and markets, and on the best-known synthesis of what has been learned about resources from research and experience. This means that soils and other resources must be classified in ways that permit them to be displayed on both general and detailed maps. The alternative potential uses must be clear for each land tract as far as our knowledge permits.

The process of community planning has two overlapping phases: (1) General planning to work out an appropriate grid or framework for resource use in a community, county, or trade area. Such a general plan includes transport requirements, broad suggestions for water control, and outlines of areas for the major uses,

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1/ I am using "economic development" in the loose general sense that includes technical, legal, social, and other sectors that are not strictly a part of economics.

including farming, housing, schools, recreation, forestry, industry, and the like. (2) Operational planning for specific highways, water-control works, housing clusters, and the like follows the general plan.

Maps suitable for displaying resources in sufficient detail for the alternative uses to be clear enough for planning individual land tracts are too large for general planning of a community, county, or trade area. For this reason published soil surveys include both a small-scale general soil map and a large-scale detailed soil map, along with interpretations of the units shown on each.

In actual practice we seldom begin with a "clean slate." People live in these areas now. They are using resources. They have goals both as individuals and as groups. They need full opportunities to explain their goals. Such facts are part of the data needed in arriving at decisions. Certainly we can agree that people need the best data and projections for making their plans. It is also true that few plans can remain fixed. New technology gives new opportunities and changes competition among land uses.

Role of the expert

When our Constitution was written, most public responsibilities over private lands, such as zoning and land-use regulations, became a function of State governments. Counties and municipalities receive their legislative authorities from State legislatures.

If plans are to be acceptable and are to be carried out effectively, the decisions must be taken by local boards or groups established for the purpose. Even more, if such boards are successful, they must draw into their planning all the citizens to be affected by their decisions.

Thus, I hold strongly to the view that those of us working with resources in the Federal government and in the universities must see our role as consultants and specialists, not as decision makers. We gather data about kinds of resources from wherever research has been conducted and use experience has been studied under similar conditions--within the local area, the State, or other States, or in other countries. Our job is to furnish citizens of a community all the reasonable alternatives, and predictions of their outcome, in as nearly quantitative terms as possible. We should assemble the data and synthesize them in terms that can be understood.

We can call the attention of local boards to successful planning and zoning under comparable conditions elsewhere. We can suggest uses and patterns of use for their consideration. But we cannot make the decisions. Even if some boards should ask us to do so, we must resist. Unless local leadership accepts the responsibility for decisions, our efforts and theirs can be wasted.

Objectives in planning

Certainly we should help people look ahead. We can do this with projections and trends of population and of demands for goods and services.

The principle of combined resource use needs emphasis. I mean this partly in the sense of using the same tract of land for two or more uses, say for example, forestry, wildlife, and recreation. But mainly by combined resource use I mean using different areas for different purposes in ways that result in the most effective pattern of uses for economic development and adequate common services--transport, schools, health, recreation, and so on.

Seldom does farming alone pay all the cost of services. For example, a look at the Midwest shows how widely transport costs are shared. In any community with farming, forestry, and industry, the more each segment prospers the greater its contribution to the services used by all. Farmers, businessmen, and labor all benefit. Thus, each group should have a voice in the plan.

Further, in local communities it is much easier for such groups to cooperate than it is for their representatives in State and national organizations. Where all live in a community, county, or trade area, poor schools, health facilities, roads, or buying power affect all. Thus in community planning, compromises in the local public interest can be most easily reached.

We now face some special problems in farming, growing out of our great but uneven progress toward increasing efficiency in agriculture. Parenthetically, I should like to add that many of us overlook the progress in the nonfarm segments of agriculture that has been fully as dramatic as in the farming sector itself.

Yet the rate of change in farming is now so rapid that if we perfect a new and better combination of practices for some kind of soil, and if it works well, it is already nearly out of date!

This progress comes not only from science and technology along individual lines, but even more from interdisciplinary research and application of the principle of interactions. Every field of crops that gives a good output for the inputs has a proper combination of practices for a balanced supply of plant nutrients, for moisture when the plants need it, for varities of crops with the genetic ability to respond, and a sound scheme for pest control. All these interact with one another and with the local soil. In addition, practices for controlling torrents and other hazards are needed on some fields. Thus, what we are seeking is a combination of practices suited to a particular kind of soil. These combinations vary widely among kinds of soils. As our research has gone forward, the results have affected kinds of soil unevenly. Some kinds that were highly prized 40 years ago are no longer considered suitable for crop use because they are not responsive to new methods. Others that were thought to be unsuitable 40 years ago are highly responsive to new combinations and are now among our best arable soils. Today large areas of these highly responsive soils are still covered with brush and trees.

During much of the time since World War I, farmers could produce more than the market would take at reasonable prices. Now

we may be entering a period with greater demands for farm products. As the situation changes, those advising farmers need to point out how the different local kinds of soil respond to current practices. Many acres that have been cultivated, even during the past few years, should not be continued in farming, not primarily because of the hazards of soil blowing or erosion, great as these may be, but because continued attempts at farming them can only contribute to rural poverty.

The national programs aimed at balance in farm production have lacked a pooling of national responsibility under the Constitution with the State authority for rural zoning and land-use regulations. I should not want to speculate on precisely how these responsibilities could be harmonized but certainly in the interest of avoiding wastes of money, both public and private, of resources, and of human labor, some scheme should be looked for. We have so much land with highly responsive soils for farming, and not now used for farming, that it seems a pity to use unresponsive soils with low outputs for the inputs.

Zoning and land-use regulations can help us guide industrial and residential expansion in rural areas where investments will be most productive. The public and private investments in these uses are even higher per acre than in farming. We also have in the country, and in this State, abundant land with soil suitable for housing. Yet, in one way or another, clusters of houses are

being built where the houses are not stable. They slide down hill, they crack up, they get flooded, or their septic filter fields fail to function. In fact, the annual benefits from some of our recent soil surveys used to guide these developments have greatly exceeded the total cost of a soil survey intended to last at least 25 or 30 years.

Some kinds of soil that are not suitable, or not needed, for farming or housing are well suited to other uses. Many people are now considering recreation as an alternative. With the growing numbers and affluence of our population, more recreational space is needed, especially within bicycle distance of homes, and some in distant areas. But here too, the demands for comforts and facilities have changed a great deal in recent years. I should think that in Minnesota some tough analyses in depth on the future trends and volume of recreational opportunities would be very useful. Without this kind of knowledge, communities and individuals could miss the mark a great deal, either way, on both the volume and kinds of recreational services that people can be expected to use.

Basic data on resources

As a firm general principle, surveys of soils and of other resources should be based on the best scientific methods we have, quite regardless of the present land use. In fact, raw information on current land use can be quite misleading.

With a classification of the soils, including subdivisions for any significant differences in climate, information available from research and from analyses of empirical experience can be assembled by kinds of soil. From these data, alternative uses and management systems can be defined, together with estimates of their outcomes. With appropriate differences in technique, similar data and predictions can be had for other resources.

For interpretations to be sound, examination and mapping of the resources must be based wholly on the nature of the resources themselves, including their relations to other resources. With changes in demand, transport, and so on, interpretations can be updated. For many planning purposes, single interpretations may be usefully highlighted. Examples include hazard of flooding, stability, permeability, seasonal wetness, and many others.

Role of the University

Your Institute of Agriculture is essentially a knowledge center for inquiry and education about soils, water, plants, and animals; their interactions; the technology of manipulating these resources and the products from them; and their economic and social relationships to the people who use them and live by them. Other colleges in the university, of course, have some of the disciplines vital to the teaching, research, and extension of your Institute.

During their development, the land-grant colleges of agriculture have had both formal and informal cooperation with the U. S.

Department of Agriculture. They have had close relationships with farm organizations and, more recently, with groups in other sectors of agriculture. Especially through cooperative extension the colleges have formal relationships with county governments. I am simply reminding you that you have had national, regional, State, and local relationships and commitments of the greatest significance. Compared with other colleges in the university, these relationships of the college of agriculture are nearly unique.

We have already emphasized the great changes in agriculture. These have changed the responsibilities of colleges of agriculture, commonly said to be the "people's colleges." Sometimes I have wondered whether or not they had been fully committed to this principle of working with all the people who need their skills? It seems clear that our inherited traditions and beliefs are inadequate for the years ahead. Those who came before us unconsciously assumed that if farmers were taught to look after their soils, water, plants, and animals, in the proper relationships for high output on a sustained basis, we would be serving all the rural people adequately and, indirectly, all people.

Even if we expand our basic assumption of efficiency to all agriculture, it does not follow that all people who use or live by renewable natural resources will be served, will be educated,

or will share in the social services urban people now enjoy. The application of technology raises problems that cannot be solved simply by more technology.

I assume that this understanding has motivated you to think more broadly about community development and welfare. We could talk about rural poverty, about the slow progress of educational opportunities in rural areas, about environmental controls for healthier living, and many other problems related to the use of resources.

On these problems of resource use in relation to people, colleges of agriculture have great opportunities. Many of the principles they have worked out to solve farm problems are directly applicable to many other kinds of problems. What we need to know about a soil to advise farmers is the same as what we need to know to advise home builders. The interpretations are different but the basic principles are the same. Further, the interdisciplinary approach to both basic and problem-solving research is highly developed, at least in the leading agricultural colleges. People in agricultural extension have carried this principle over to the diagnosis of actual problems and to the application of research results.

Cooperative extension has had long experience working with individuals and groups and with organizing local people for special programs. No other State institution with responsibility to help

meet the problems of resource use within a State has had comparable opportunities, experience, and organization. Yet, up to now these experiences have not been fully applied to the problems of community planning for good living and economic development. Many thousands of houses are being built that will not endure; a lower proportion of rural youth go to college than urban children, even in Minnesota. For many reasons people are using soils and other resources in ways that will not return optimum benefits to them or to their communities.

Perhaps some of our land-grant universities have been waiting to respond to pressure rather than taking the risks of leadership. Partly we waste time trying to separate "agricultural" from "nonagricultural." Even if such a separation were somehow helpful, it would be very difficult to make. Increasingly the agricultural sector is intertwined with other sectors. Is the transport system agricultural or nonagricultural? The banking system? International trade negotiations?

Agriculture has been increasingly urbanized. Rural people have moved to the city. Now city people are moving into rural areas. On the average in New York State, each farm family has six nonfarm neighbors. I don't know what the comparable figure is for Minnesota.

We simply cannot separate planning for farm people from planning for nonfarm people, or planning for agricultural enterprises

from planning for nonagricultural enterprises. Community planning must serve the needs of all the people in the community. Unhappily, in the midst of a growing technology, much of our expansion has taken place without systematic use of what is known or of what we in agriculture have the skills to learn.

Natural Resource Center

In order to make full use of the vast information and skills we have in agriculture and to capture what we have learned about interactions and interdisciplinary research, I should like to suggest that you consider a natural resource center as a part of your Institute of Agriculture. Teaching, research, and extension would all have a prominent role in such a center. Each faculty member, including extension specialists, would be firmly based in the department of his discipline. Each student would likewise be based in a department. All the traditional avenues of cooperation with other colleges of the university and with other Federal, State, and local agencies would be used.

Recently much successful experience has already been had across department lines with committees, centers, or institutes on genetics, water, biology, and other areas that overlap between disciplines. In our stress on interdisciplinary research and education we continually speak of the importance of having people from different disciplines work together. Yet depth of learning is as important as breadth. Every scientist needs to work with his peers as well as with others.

College departments thrive best when organized by disciplines. Rarely have I seen any advantage from combining unlike disciplines into one department. Where this has been done, one discipline or the other, or both, nearly always suffer. In standing committees, centers, and institutes, staff members are brought together for interdisciplinary work. I should like to repeat that I simply cannot conceive of success by such a center placed in one department. After all, departments do compete for funds, staff, and especially prestige. Experience has shown clearly, to me at least, that departments by disciplines are essential for continued depth in scholarship. Departments set up by broad problems usually fail. Our emphases on problems change. As they do, old centers, committees, and institutes can be phased out and new ones established. Now we can all see the need for interdisciplinary research in environmental science, for example, that would also require the attention of scholars from several departments.

Extension would have a vital role in such a natural resources center. It has had a long experience in helping people. It does not compete with school boards, county governments, soil conservation districts, or other local organizations. Rather it performs a staff function for all of them. The active county agent knows the objectives of all the State, Federal, and local agencies working in his county and helps explain them to the people. This educational role has been highly important. Certainly it should continue.

Then too, the effectiveness of both research and technical assistance to communities will be greatly strengthened by emphasis on your traditional cooperation with agencies of the U. S. Department of Agriculture that also have experience and responsibilities in this broad area. As one example, I hope we agree that the programs of both your Institute of Agriculture and the Soil Conservation Service now benefit from such cooperation. Perhaps even more could be done to our mutual advantage.

Traditionally the strong colleges of agriculture have backed up their extension programs with research. As any new areas of service are undertaken, the same principle needs to be emphasized. Obviously, success in community planning calls for a great deal of interdisciplinary research.

As other colleges of the University undertake extension, they need to understand this principle. People need time to do good extension work; it cannot be something extra for the left hand in idle moments. And it must be backed up by good scholarship and research in the departments. Just now, cooperative extension has a wonderful opportunity for service that I wish very much they would take. Many other colleges and departments are going into extension. I hear a bit of criticism about this from some people in agriculture. Some even say, "Those people in the arts and sciences who come from the Ivy League colleges do not understand the public service responsibilities of the university." Why

don't they? One reason could well be that we in agriculture have not, insofar as I know, written for these people a straightforward synthesis of the basic principles learned during the last 50 years on how to carry on extension. Some of the emotional statements about extension seem to suggest that if one wants to learn how to do it, join the fraternity, follow us around, and get it by osmosis. This is nonsense, of course. What has been learned can be written objectively so that other educated men can understand it.

If you are to make a success of community resource planning in Minnesota, which I very much hope you do, you will need the help of many other people outside your Institute. And they can help you a great deal more if you give them the benefit of what you have learned and in straightforward nonemotional terms.

How well you do this in full cooperation within the University and with other State and Federal resource agencies will be at least one measure of your imagination, sincerity, and sense of urgency about community planning to help advance the well being of the people you serve in Minnesota.

WORLD FOOD PRODUCTION PROSPECTS AND POTENTIALS: A LONG RUN LOOK

An address by Charles E. Kellogg, Deputy Administrator for Soil Survey, Soil Conservation Service, U. S. Department of Agriculture, at the Center for Agriculture and Economic Adjustment, Iowa State University, Ames, Iowa, November 8, 1966.

World food potentials in terms of acres of responsive soil and of water available for farming are very large. The big questions are:

How to make a significant start in agricultural development, country by country?

How to give cultivators incentives to produce beyond family needs?

How should the other sectors of agriculture be related to farming?

How to establish viable institutions for education, research, advisory services, and technical assistance, appropriate to local social and natural environments and levels of economic development?1/

How to arrive at priorities for investment and for combined resource use to share costs of transport and other facilities and to contribute to economic growth?

Causes of Current Imbalance

Why does this problem seem so acute now? It is due to more than population growth, important as that is. The enormous pressures to increase food, other consumer goods, and living standards in the underdeveloped areas of the world result from several important new factors.

1/ The term "economic development" is used in the usual general sense that includes many legal, technical, and social activities outside the field of economics.

(1) Medicine and public health measures, developed mainly in the advanced countries, have been introduced in the underdeveloped countries, especially since World War II, without parallel efforts in agricultural development. Thus in many areas populations have rapidly increased. In such areas, large increases in production are necessary even to maintain current standards of living.

(2) At one time agriculture was mainly farming. Most of the work was done on farms. In the United States now, only about one-fifth of the labor force directly engaged in modern agriculture, which the undeveloped countries want and need, work on farms. Most work in the service and industrial sectors of agriculture. For agricultural development anywhere these sectors must also have emphasis, not simply farming alone.

(3) With improved communications, people in the underdeveloped areas know more about the abundance of advanced countries. They now believe that the plagues and famines their forebearers took for granted are no longer necessary. They want to have living standards comparable to those of the people in the advanced countries.

(4) For years people in colonial areas had been told that all their troubles were caused by outside interests. After political independence they had greater expectations from their new governments than could be realized in a short time.

(5) With the urge for more consumer goods, especially by the rising middle class, too much emphasis tends to be placed on industrial

development outside of agriculture. In many of the undeveloped countries cultivators have low social status and both rural people and agriculture remain neglected. More people must appreciate that every advanced country of the world got its start toward economic growth from an agriculture producing a surplus. Nor could economic development be sustained amidst an inefficient agriculture giving low returns to labor.

Acres Available

According to estimates made in 1964, the acreage of arable land could be approximately doubled (6). With economic methods to take the salt out of saline water for irrigation, and especially to tap unused supplies of nonsaline stream water, even more acres could be developed should the need continue to increase in later years.

The effects of modern science and technology are to increase the number of potential arable acres. Some of the most responsive soils in use today, for both crops and livestock, do not give reasonable returns by the methods of only 35 years ago. Research and invention in the Tropics can be expected to give further enormous increases in the number of acres that can be cultivated economically.

The unused potentially arable land is not evenly distributed by countries or by population. Yet few countries are too limited in soil resources for an abundant food supply. Among those with large populations, mainland China may be most severely pressed to increase yields and to develop more arable acres.

Both South America and Africa, especially Africa south of the Sahara, have truly enormous potentials. North America could expand its

arable land by well over 500 million acres. Much new arable land can be developed in southeastern Asia, especially with integrated development of the river systems. In most of this area and in Africa and South America, yields of both industrial and food crops could be greatly increased. With agricultural development, much good land now used to produce feed for draft animals will be released as other sources of power are substituted for them. This has happened in all the advanced countries. Japan has made dramatic changes since World War II by substituting small tractors for draft animals.

The early developments of commercial farming were located near good harbors and spread out with new transport services. After early European settlement in New England, and even earlier still in the Southwest, it took the people of the United States nearly 200 years to find their largest areas of highly responsive soils in the Midwest even though two great river systems led directly to them. Today's world maps showing where various kinds of crops and livestock are produced do not necessarily show the acres best suited to these uses. Rather they show where transport is available to areas at least moderately well suited for them. For most crops, equally good or better areas of soils do not show on the map. Some such areas of potentially good soils have subsistence villages far from roads; others lack even subsistence farming.

What Acres to Use

As already pointed out, the amount of arable land could be about doubled. Perhaps yields could be somewhat more than doubled. In

India and Pakistan, for example, they could be increased more than that. These generalizations relate to the physical and biological potentials if suitable institutions were developed.

Could this development be carried out economically in the underdeveloped countries with existing transport and institutions by cultivators developing and managing the new land with the methods now used and understood by the bulk of them? The answer is "no." In fact, the 200 million or so following shifting cultivation and with no roads within 10 to 25 miles of their homes produce little food beyond their family requirements.

Should a higher priority be placed on bringing in new arable acres or on improving the efficiency of use of the present arable acres, considering both farm management and improvement in the industrial sector of agriculture?

The answer varies widely by countries and by areas within countries. India, for example, has large areas of potentially excellent arable soils now in use, but with production limited by lack of education and management skill, by scarcities of production supplies, by lack of effective grading and marketing of farm products, and by inadequate processing and storage. Here one would put a low priority on bringing in new arable soil and high priorities on (1) better soil and water management on the highly responsive soils already in use and (2) on the improvement of agricultural services. Returns for labor, investment, and managerial skills would be greater and quicker.

What holds back development of new arable lands in areas having great potentials of unused soil resources?

Effective transport by rail, highways, or modern ships is an important reason that applies to great areas in Africa and South America. Commonly, the essential transport is too expensive, or at least seems to be, for financing it out of farm income alone. Not many transport facilities anywhere are now financed by farming alone. Thus, in planning for economic development, exploratory soil surveys to locate responsive soils need to be supplemented by exploratory surveys of such resources as forests, minerals, and water. Other promising developments can help supplement new farming schemes on good soils and the costs of transport and services may be shared. Thus, more emphasis must be given to combined resource use.

Systems of soil use in many countries are primitive by our standards. But changes in these call for great social, legal, and institutional changes in societies for which no clear models are available. Certainly there are eternal verities among men but the changing patterns of national institutions must be worked out locally.

What holds back improvement of efficiency on highly responsive soils now cultivated with low yields? Failures to grasp the important principle of interactions is the greatest technical handicap in field planning, farm planning, community planning, and country planning.

How to Get Started Toward Agricultural Development

Before reminding you of some critical items, which by themselves are well known, I should like to mention three general sets of attitudes or assumptions of vital importance in getting started.

First, a person from any one country must avoid assuming that the people in another country, village people especially, want the same things that he would want if he were going to live there. Much wasted effort has come from such unconscious assumptions and from encouraging people in a position to help the cultivators to make similar assumptions. Actually, people in many villages want quite different things than an American would want if he were going to live there. Unwittingly perhaps, we also encourage many foreign students who are here for study to want things that are not appropriate in their home country.

Second, it must be understood that agricultural improvement is essential to general economic progress, not something separate. But countries have great opportunities to assist both agricultural and general economic progress by placing a high priority on those items that help both (3). Up to now most of us have overstressed direct help to the cultivators and neglected education and the industrial sectors of agriculture without which an efficient modern agriculture of abundance is impossible. Pressures for middle-class luxuries should not be allowed to interfere with priorities for developing the industries and transport necessary to make agriculture productive and able to fill its traditional role of stimulating economic growth.

Third, we must be continually aware of the interactions among the several factors involved. Someone has said, "Nature and man must make a great many right combinations to have even a mediocre corn crop."

To take a simple example of interactions from soil management: Every productive acre has a minimum of four conditions in proper balance, as related to one another and to the local kind of soil: (1) a balanced supply of plant nutrients, (2) water and air available to the roots when they need them, (3) kinds and varieties of crops with the genetic potential to respond, and (4) protection from insects, diseases, weeds, and other hazards. To these that apply anywhere in the world, we must add control of mountain torrents, protection against strong winds, sea walls, and the like for certain soils (1,4,9).

The same principle in planning actions to support one another applies all the way up the line to country planning. Since our own economies in the developed countries grew gradually, we take for granted delicate balances and combinations that must be planned for in a less developed country if enough progress is going to be made in time.

This means that we must avoid the narrow-minded specialist[2/] who is going to solve complex problems with some one or two items--say fertilizers or price incentives, or the two together.

Now, of course, we cannot carry this idea to the extreme of doing nothing until we can do everything accurately at once. The problem is not one of getting the maximum production at once. It is as much to demonstrate to cultivators, and to those who serve them, that science

2/ No inference should be made that specialization in any way causes people to be narrow, but some narrow-minded people specialize.

and technology have a great deal to offer them (8). We should not be worried about failing to get the maximum result at once. So many times we have failed to get any result by concentrating too much on one thing by itself, or even on three or four, yet omit a critical one essential to success with the others.

Let us review some of the main steps that must be taken to get a start toward agricultural development in the less-developed areas. Many of these are well recognized so I shall spend most of my time on the ones that seem to me to be inadequately recognized. Resources are available. The people need food, education, and other facilities for worthwhile living.

Incentives for cultivators

Most cultivators work hard to produce food and shelter for their families with the resources and skills available to them. Hundreds of millions of them have inadequate resources and low diets. So they do not work when there is no point to it. The inexperienced traveler sees them resting and thinks they are lazy. People with poor diets do not exercise for fun.

How far cultivators go beyond subsistence farming depends on incentives and opportunities. First of all they must have a nearby market with fair grading. Perhaps because it is so obvious, this need is commonly overlooked as a primary condition for production beyond family needs. In less-developed countries where supplies come from poor cultivators, high prices by themselves can have nearly opposite

effects on food supplies in the general market than high prices have in advanced countries. Very poor cultivators already on calorie-deficient diets may sell a smaller amount for their traditional total cash income and keep a bit more for their own families to eat. Further, with high prices at primary markets, cultivators lacking adequate storage and local markets with fair grading may get little or none of the price increase. On the other hand, stable and reasonably attractive prices at nearby markets are essential to stimulate food production, along with good credit facilities, fertilizers, seeds, and other production supplies on reasonable terms, and with adequate advisory services. Cultivators need assurance that prices will be stable to remove the fear of very low prices in the years after they have invested labor and funds in farm improvement. Fluctuating prices lead to poor decisions on farm management (5).

Risk sharing

It is extremely helpful to have a scheme for sharing the risks of new systems with a cultivator. People like us know (or think we know) that certain combinations of practices that are expensive to install will work to the cultivator's benefit. But he does not know that. He knows that if they fail and yields are less, his family will suffer great hardships. It is entirely possible to arrive at a fair estimate of what the crop would be under the old system and to guarantee the cultivator compensation if a new system does not work out. It

might be added that such a scheme has the extra advantage of keeping those giving him advice and technical assistance on their toes. This kind of scheme has been worked out successfully with negligible cost to the government (1).

Institutions

Perhaps institution building is at once the most difficult and most important part of agricultural improvement. Rarely does one start with a clean slate. People already have some kind of provincial and local institutions. The strongest of these should be built on. It is especially difficult to develop and to make effective an entirely new institution if it appears to be competitive with existing ones. We were very fortunate in the United States to have had teaching, research, and extension together in the land-grant colleges of agriculture. But there are other ways to bring about the needed end result; nor has our system worked with equal success everywhere in our own country.

Some countries have a strong research program in the ministry of agriculture. Other advanced countries have found it better to have research in a different ministry. In an underdeveloped country, the best place for research is doubtless in the strongest existing institution. If the ministry of agriculture is concerned mainly with current trade and price questions, with little or no research background or atmosphere for research, placing the soil survey there, for example, could give it the kiss of death.

Educational institutions within the less developed countries have been given far too low a priority, in my view, by most governments and by United Nations agencies. To operate any system that approaches a modern agricultural system calls for many well-educated scientists, engineers, and technicians in farming and in both private and public industries and services. Opportunities should be available to the village youth who are already acquainted with rural life and problems. At the present time too few rural boys and girls are prepared to enter colleges and institutes of agriculture.

Further, every country needs its own colleges and universities. I am convinced that the largest part of the funds used to bring young men and women to the advanced countries for college training is misdirected. Most of the funds could be better used to help the new countries establish and develop good institutions for training people within their own cultural and natural environments. In the long run each country must be prepared to train the bulk of its own scientists and engineers, including those with graduate degrees. Certainly, I believe in exchange of students, lecturers, and professors among universities. Yet, I think each country needs to have its own first-class scholars in its own universities and research institutes to whom it may look for advice and counsel. For the newly developing countries to depend on outside countries for teaching and for intellectual leadership could become an intolerable kind of intellectual colonialism.

Good research institutes are absolutely essential in every country seeking to increase the efficiency of farming. This is especially true

in tropical and subtropical areas. Much agricultural research has been done in the temperate regions over the past 200 years. But the combinations of practices developed there are not directly transferable to the Tropics because of great contrasts in both social and natural environments. The Tropics has many more kinds of soil and of crops than temperate areas. We tend to take grain for granted. Some people in the Tropics eat a great deal of grain; others eat little or none.

Yet the skills of research and the methods of science are transferable. And many urgent problems need to be solved for agriculture to be of comparable efficiency to that in temperate regions. Nor can this research be only applied research. As soon as scientists get going on many problems, they will immediately see the need for new basic principles. Then too, in the application of basic principles a research institute needs to have people who are thoroughly familiar with them. The only way to be sure of that is for them to be conducting research in the basic areas, perhaps as a part of problem-solving research of the kind that has been so successful over the years in our Department of Agriculture and land-grant universities.

Research institutes should be broad in subject matter. Small, single-purpose research institutes commonly fail by missing the vital interactions among kinds of soil, varieties of plants, water control, animals, insects, diseases, marketing, storage, processing, and other vital factors.

Further, successful research requires continuity of effort. People on short tours can help establish such research institutes, but they cannot become effective or remain so without high quality permanent staff.

Extension and advisory services are needed. Here again, there is a tendency to take the institutions, methods, and even people who have been successful in the advanced countries to the newly developing countries. Success to date has been disappointing. The advisory services in North America and Europe were developed for literate, responsible farm families with moderate to large holdings. To have the same ratio of advisory agents to people in many of the underdeveloped countries would require a nearly astronomical staff. Until appropriate emphasis is given to education, information and advice must be given by word of mouth, posters, and demonstration. This in no way implies that the people have low aptitudes; it simply implies that different methods from ours must be used in order to communicate with them.3/

Further, the training requirements in basic agricultural science are much higher for successful advisory agents in underdeveloped countries than in the United States. Here extension people are backed up by experiment stations. Most things recommended can be had through normal commercial outlets. But in many of the places where immediate progress is urgently needed, research support is lacking. Until such institutes can be developed, extension or advisory agents must know how to diagnose problems and isolate the limiting factors. This takes rather more scientific knowledge than is normally required of their counterparts in the advanced countries.

After the problem has been diagnosed, it commonly takes a great deal of resourcefulness to find a practical way to overcome it within

3/ For good discussions of the great differences in communication within illiterate, closed societies as compared to literate open societies, see McLuhan's The Gutenberg galaxy (7).

the local cultural environment. In the advanced countries, for example, if a soil is determined to be deficient in phosphorus, of course, the advisory agent recommends phosphatic fertilizer on the assumption that it is reasonable in price, easily obtained, and within the financial ability of the farmer. Commonly, however, the cultivator has no money, no reasonable credit, and no place to buy phosphatic fertilizer. Thus, some other scheme, such as compost, must be recommended. I can assure you that compost has been highly advantageous to many cultivators considering the resources at their disposal. Many other examples could be given. If a commercial farmer in the United States becomes convinced of a 10 or 15 percent increase in yield from a change in practice, he is likely to adopt it. A cultivator in an underdeveloped country with low yields now cannot even see such a small difference. Unless the new combination of practices at least doubles his yield, he is unlikely to be interested.

Credit at reasonable terms has been suggested by many of us. Ideally, we think of cooperatives and credit unions. Yet these sophisticated institutions are not easily developed for a village or group of villages where a few people have customarily dominated both credit and marketing. It is easy to find many new cooperatives that are run as joint-stock companies for the benefit of the upper 1 percent of the cultivators. I agree that great effort should be made in these directions, but institutions directly supported by the government may be necessary until cultivators have more education and more experience

working together for their common good. Further, credit for the essential industries and services of agriculture is as important as credit for the cultivators.

Technical assistance from either public or private institutions is available for laying out terraces, irrigation runs, drainage systems, and land leveling in many of the advanced countries. In some underdeveloped areas project work for irrigation and drainage stopped with building the main canals or furnishing wells and pumps. Land that appears level to the casual observer may be altogether too uneven for efficient irrigation. Under such conditions the cultivator uses far too much water in trying to moisten the high places with the result that he waterlogs the field as a whole. Irrigation does not pay either the cultivator or the government unless quite a good job is done so that soils respond to good varieties and additional fertilizers.

Land tenure is highly important in every country. Most people here realize that we have some rather serious problems of land tenure that are getting little emphasis in our own country. I cannot take time to go into the whole highly technical and highly emotional problem of land reform except to say that simply splitting up large land holdings into small fragments for individual families, and thus dispersing management responsibilities, can lower production. Land reform can help production a great deal provided the necessary education and services are available so that families know what kinds of decisions to make and have the skill and materials to carry them out.

I should like, however, to emphasize strongly the need in many countries of a special service for the consolidation of fragmented holdings.

The successful schemes used in western Europe are not necessarily good guides in the underdeveloped countries. In Europe it has generally been practicable to develop and carry out a plan so that each operating unit is in one land tract. Such a scheme is not practicable in many areas having an intimate pattern of highly contrasting kinds of soil. Such a plan, if it could be completed, would leave some cultivators without soil suitable for cultivation with the traditional crops. Certainly it would not be possible to get a village to agree to such a proposal. To make progress, it is commonly necessary to consolidate holdings within some two to four groups of soils. For example, I have observed an excellent scheme developed along this line in the village of Nawdika near Hazaribagh in India. A part of the village lands consists of gently sloping soils of good quality. A critical feature for their management is a system of terraces at slight angles to the contour. The excess water that did not enter the soil escaped through a grassed waterway into a stream. The remainder of the village land is hilly and disected. The soils are suitable only for growing coarse grasses to be harvested by hand. When the project was finished, individual cultivators had a consolidated tract, bounded by terraces on the upper and lower side, and a fraction of the rough land. These improvements alone doubled crop yields. With better varieties, proper fertilization, and improved pest control, production could be expected to be at least five times the original. These developments obviously

require accurate soil surveys for planning, for gaining the confidence of the cultivators affected, and for reasonable success. I regret to say that many schemes for consolidation of fragmented holdings, as well as for settlement on new lands, have been planned arbitrarily with little or none of the essential field research by competent people. These have failed.

This sort of planning is required on a large part of the best of the presently cultivated land in warm countries with seasonal rainfall. Without proper water control, new varieties and fertilizers cannot be effective; and the proper water control cannot be had with the present helter-skelter arrangement of parts of holdings in 5 to 15 fragments.

Arrangements for multiple-purpose planning and priorities to maximize the development of agriculture with the resources available must be developed by each country in relation to their institutions. Such planning must be done at a rather high level to involve all the major related developments that share or provide services used for agriculture as well as those that may compete for scarce foreign exchange, professionally competent people, and skilled labor (2).

Services in the private sector are needed. Many people in newly developing countries are afraid of private business from advanced countries. Because of unhappy experiences with monopolistic companies, they need help to see the advantages of competition and how to arrange for competitive private enterprises in the industrial and service sectors of agriculture.

Also companies in advanced countries can help themselves and newly developing countries by designing goods and services to meet their needs, rather than pushing sales programs for the items currently used in the modern agriculture of advanced countries.

Summary

Finally, to go back to the "long run": From a physical and biological point of view the prospects for an efficient, abundant, world agriculture are excellent. The main road blocks are institutional. But I do not mean necessarily the same institutions as we have in North America and Europe. Rather, I mean comparable institutions that can achieve results within the social and natural environments of the less developed countries of the Tropics and subtropics, and that can change as development proceeds.

The people in these countries need education. But so do we if we are to help them effectively. Professional agriculturists in the United States, for example, must open their minds to many additional fields of knowledge than most have formerly. History, literature, philosophy, communications, cultural anthropology, and comparative religion, for example, are all "practical" subjects in this context. On the other hand, emotional approaches without firm natural and social science are likely to do more harm than good.

As a people, we must ask ourselves, for example, what products shall we take from these countries in trade during the development

period? Look at what the United States sold to Europe during our development period. We cannot expect changes rapid enough to avoid revolutions, wars, and other calamities without making some adjustments ourselves.

Although I have lived in the United States and know something of western Europe, this side of the equation, in the advanced countries, presents great uncertainty for me. I know only that the problems could be met. Success is within our grasp.

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A FORWARD LOOK AT SOIL USE IN THE UNITED STATES

An address by Charles E. Kellogg, Deputy Administrator for Soil Survey, Soil Conservation Service, U. S. Department of Agriculture, Washington, D. C., before the Soil Conservation Society of America, Des Moines, Iowa, August 15, 1967.

Our knowledge about the soils of the United States has grown enormously during the past 45 years or so. Within each decade we have learned far more than in the previous one. Knowledge has grown likewise in the other earth sciences and in such related fields as plant breeding, plant protection, engineering, and economics.

In the past 45 years we have passed through a long major farm depression and a shorter general economic depression. We have had one major war and two others. Since the early 1920's our birth rate went down, rose sharply, and now is again declining. We met successfully heavy commitments to help the countries of western Europe recover from the disasters of the Second World War. We continue to have commitments to help other less fortunate countries, including many with new national governments, raise their living standards and preserve their political integrity.

Naturally, such great social changes and the growing use of new technology have enormously affected soil use, and will continue to do so in the future. We have made adjustments, to be sure. Yet despite the record of the past, our soils could be contributing much more to our national purposes.

Changes in the Potentials of Soils for Farming

The United States has an enormous variety of soils--many thousands of kinds, each with a unique set of properties. They vary widely from one another in their responses to changed systems of management. Modern farming systems are combinations of interacting practices: better and cheaper fertilizers; water control--drainage, irrigation, runoff, and combinations of these; smoothing and shaping of the soil surfaces; cheaper and better methods of land clearing; improved varieties of crops, grasses, trees; methods to control diseases, insects, and weeds; and improved machines for tillage and harvesting.

Nearly everyone understands that application of the technology growing out of science to the selection and management of soils has raised yields and increased the efficiency of production. The effects can be very large on some kinds of soil and insignificant on others. Yet, people are less aware of the effects that new technology has had of enormously improving the potentials of soils that were formerly unsuited to farm use.

Technology raises soil productivity in two principal ways: (1) by direct effects on sustained yields of specific crops, either traditional ones or new ones, and (2) by the selection of uses for different kinds of soil. Many of our most productive soils for vegetables could not be used for them economically without fertilizers. Nor, for example, could we have economic production of sugarcane or pineapples in Hawaii without fertilizers.

In considering changes in average yields or total production of a crop in some area, say of corn in Georgia, account must be taken of both the direct effects of new practices on responsive soils and of soil selection. Increases in State average yields per acre, adjusted for climatic variations, are partly accounted for by the replacement of corn on the sloping soils by well-fertilized forage. Corn was shifted to less-sloping soils more productive for corn. Thus, the trends of average yields over the past four decades of corn in Georgia, or of potatoes in Maine, partly reflect improved soil selection. These crops were grown on different kinds of soil over the period. Unless we study the causes of such trends, we may attribute more to the effects of new management practices than was actually realized by them alone. Part of our yield increases would not have taken place without better soil selection.

Some specialists make an indoor sport of showing how rising yields are related to the particular input in which they are interested, say fertilizer, insecticides, improved seed, or some other one. Now it may be true that if fertilizers were removed from the combination of practices giving a high yield of some crop in Florida, say, production would drop by 90 percent; but this does not mean that the 90 percent was due to fertilizers and that only 10 percent accounted for the effects of the soil, water, sun, labor, and everything else. To substitute an old variety for the current one might also have dropped yields by 90 percent. Abandoning the practices for controlling diseases, insects, or weeds could have dropped the yield by 90 percent.

The final yield results from a host of interactions between the properties of the soil and its associated physical environment and the several components in the management system. Thus, in designing the most rewarding system, the farmer should be seeking the maximum benefits from the interactions among the practices and his local kind of soil (2).

As time has gone on, the relative advantages of different kinds of soil have changed a great deal. Many of the sandy soils of the southeastern Coastal Plain came to have far greater potentials for crops and forages after the 1940's than they had had earlier. In their natural state these soils have a low supply of nutrients for crop plants. While fertilizers were low in quality and expensive, soils with more plant nutrients seemed to have economic advantages. Beginning in the late 1930's and extending through the 1940's better fertilizers became available at much lower farm costs. Plant breeders developed better varieties. Improved methods became available for using ground water and for control of surface water. Now many of the sandy soils of the Coastal Plain are among our most productive farm soils.

Farming is extremely competitive. Obviously, if the relative advantage of some kinds of soil is increasing, that of other kinds is going down. Thus in many areas the use of some kinds of soils is being shifted from crops to extensive pasture or forests. Yet other forested soils are being cleared with new, cheaper, and better methods to produce specific crops for which the soils have a high potential, such as soybeans on some of the smooth soils in Louisiana.

In addition, examples could be given from most parts of the country of soils having greatly increased potential from new technology.

Effects of Urbanization of Farming

During the past 45 years commercial farming itself has become urbanized. Statistically, farm laborers have moved to towns and cities where they make machines and chemicals for farmers, process farm products, and perform other vital services in agriculture. Today's commercial farmers have far higher operating budgets. What they are buying is primarily labor in the form of machines, chemicals, electric power, oil, and the like. I can recall not many years ago when southern hostesses were famous for their chicken dinners. Before electric power and refrigeration this was about all the fresh meat that could be counted on. What an enormous change cheap fertilizers and electric power have made in the commercial farming of the Southern States! Even now these great potentials are only partly realized.

Further, commercial farming requires far more knowledge of economics and business than it did formerly. A small mistake in a commercial farmer's operating budget can be serious. The commercial farmer today knows more in depth about his enterprises, and he has fewer of them than his grandfather did.

We can recall the papers written during the 1920's and 1930's about the great release of farmland for cash crops resulting from the substitution of tractors for horses and mules. Because our current food processing and marketing services grew more slowly, we are less aware of the enormous reductions of waste between the farm and the

consumer. This has had the effect of making our acres more effective. We could add here that perhaps the consumers received more benefit than farmers from modern food processing; or was it somebody between the farmers and the consumers? But anyway, the developments in food processing have been fully as dramatic as those on the farms themselves.

In a broad way the new developments in the industrial sectors of agriculture interact with farming systems. Some time ago engineers developed a new machine for picking tomatoes. Yet farmers could not use it until the plant breeders developed a variety on which all the fruits ripened at the same time. I recall the remarks of one of my associates when these two were put together: "This means a decline in 'agricultural' labor." The obvious question is: "Who will make the new machines, the dwarfs in the Black Forest?" I have been completely unable to understand why it is that if a man moves from working on a farm to working in a factory to produce farm machines and chemicals he ceases to be counted as agricultural labor.

I expect this process of urbanization of farming to continue. We shall have problems--problems of understanding what agriculture really is and of distributing the returns from the sales of agricultural products and services equitably.

Balance in Soil Use

The pronounced effects of science in agriculture, including farming, have come remarkably fast in terms of the life of an ordinary

individual. We now have about 50 million acres of soil used for crops, or with an official cropping history that makes them eligible for crop use, that are not suitable for economic farming under any known combinations of practices. To me this is a great pity. Some of these soils may suffer further deterioration from soil blowing and erosion that makes them even less suited to their adapted uses under the current system of our knowledge of how to use them. Such blowing and erosion makes a public nuisance. But far more important to me is the fact that continued use of these soils by people contributes to rural poverty of which we already have too much.

On the other hand the people of the United States have around 230 million acres of soils--not counting Federal land, urban areas, highways, or idle land--suitable for cropping but not so used. Most of it has a cover of brush, trees, or grass. Roughly one-third of it is in the southeastern part of the United States that we discussed a bit earlier. But substantial acreages of soil suitable for cropping but not cropped are in the Midwest and in several other areas too.

In figure 1 the proportions of soil acreages suitable and unsuitable for crops, and the proportions of each used and unused for crops are shown for the non-Federal lands used in 1958 for crops, pasture, range, or forest by broad resource regions (1). Acres of Federal land, water, urban land, rural land used for residences and the like, and idle rural land are excluded. The charts show the proportions within each region based mainly on the conservation needs inventory

of 1958 (4). Soils in capability classes I, II, and III were considered suitable for crops. Those in classes V, VI, VII, and VIII were considered to be unsuitable. (Actually, a small percentage of these soils is suitable for certain horticultural and other special crops.) Soils in the subclasses of class IV were distributed between "suitable" and "unsuitable" in accordance with my judgment and experience in the different regions.

A transfer of some 50 million acres of cropland with unproductive soils for crops to noncrop uses and the bringing in of an equivalent acreage from the 230 million or so acres of potentially productive soils for farm crops would be difficult to arrange. People have money invested in their farm homes. They have personal attachments to their communities. I am aware that some things are more important than efficiency. But at least it should be possible to encourage gradual shifts and to discourage any new developments that would lead people into poverty.

Also I hasten to add that some soils suitable for farm crops can be used most effectively for commercial forestry. This would include areas in isolated places and others near expanding communities needing recreational space.

Community Development

As farming became more urbanized, people moved from farms to towns and cities. Many of them found jobs in the industrial and service sectors of agriculture. Others found jobs in other lines of

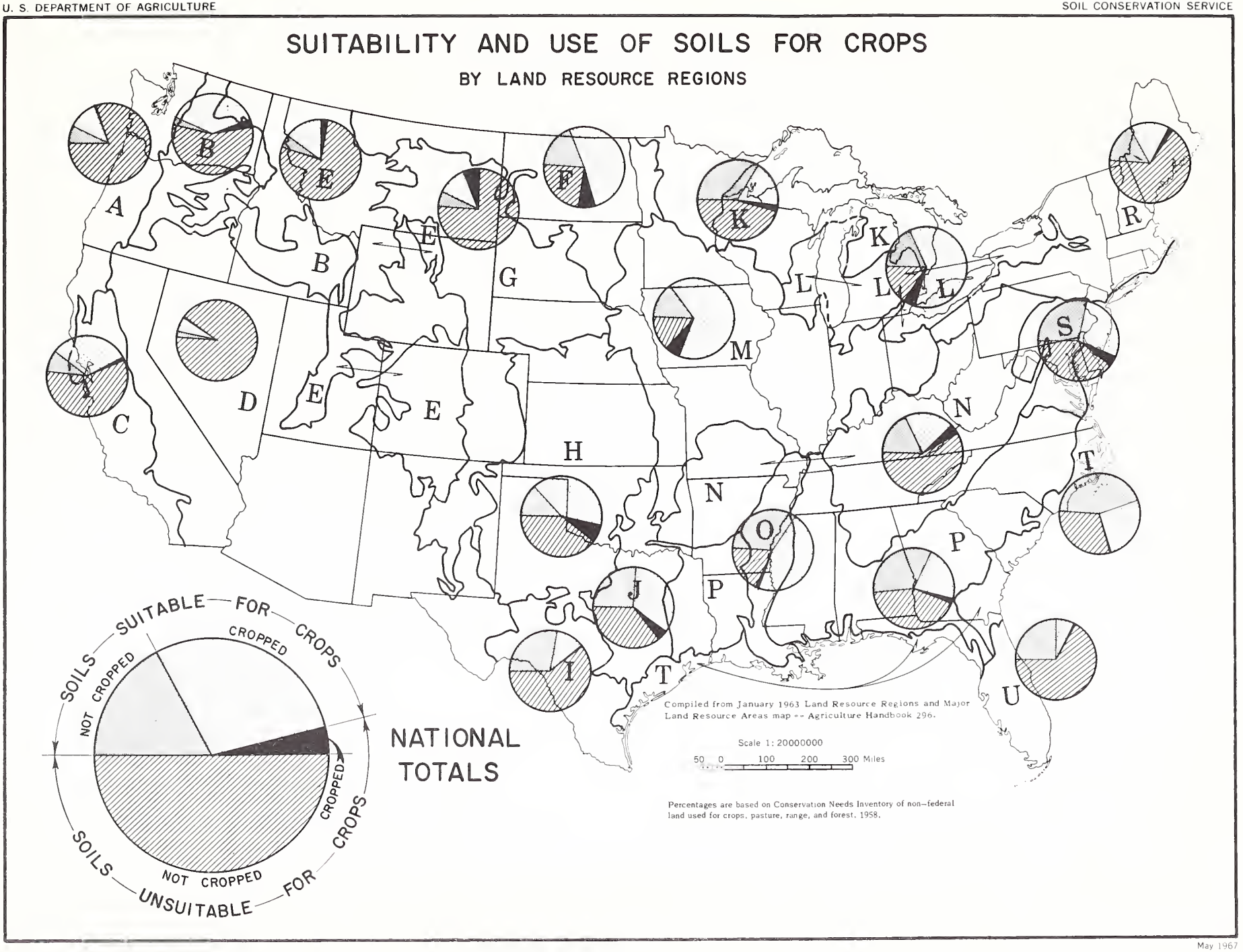

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Figure 1.

economic activity. Before the First World War, more than half the people of the United States lived in the country. After that war more than half of them lived in the cities. And the trend continued in that direction until after the Second World War. Now many of them are moving back into rural areas, not as farmers but to live in the country and work at other occupations.

We have all read a lot now about the problems in our congested cities--problems of juvenile delinquency, pollution, crime, and so on.

Most of our cities were located near water transport--on the margins of oceans, big lakes, or streams that could be navigated. Many of them started very near the water's edge. In such places we find our most complex pattern of contrasting kinds of soil. Oceans are working away at the land and so are big streams. The land on which my office building in Washington is located has been invaded by the ocean three times. At the moment it is dry land. Thus, partly for geographic reasons our cities are located rather badly for stable houses and streets.

Then came the steam engine. With this new source of power the productivity of individual workers was enormously increased. But steam cannot be transported far. And it was difficult to transport workers far in those days. For both reasons people in industry got huddled into compact areas. We now call them "ghettos," "slums," and the like.

Later, electric power became available to increase further the efficiency of individual workers. Now it is cheaper than a few years

ago. And electricity can be transported very much farther and more cheaply than steam. People have telephones, busses, and automobiles. No longer are there compelling needs to huddle industries and people into compact areas.

As we said, people have started to move out of the central city, but mostly not far enough. They first moved into compact suburbs around the central core and yet still a part of the city. Then with more highways and elaborate cloverleaves they moved a bit farther. Most of this housing has not been far enough from the central city to get outside the complex soil patterns of the original location. In anticipation of new housing, land prices near the cities skyrocketed. Enormous windfalls came to those who happened to inherit such land. In many places, three or four subsequent owners each received a windfall.

Now people are beginning to see the advantages of moving out beyond the suburbs. To me the advantages are enormous. Perhaps this is due to some agrarian prejudices. We have the opportunity to develop communities, and many have already been developed, that include farming, forestry, recreational areas, industry, and residences. These can remain viable if people make zoning ordinances that are honestly administered. A community does not need to bulldoze all its farmland or forestland out of use. Certainly some farmland needs to be used for shopping centers, playgrounds, and houses.

People now have many more tools for estimating population growth and their needs. But some future events cannot be foreseen. Perhaps the greatest skill in community planning is the one of being able to

decide on those items that can be foreseen and those that cannot be, and to provide essential flexibility. For this reason alone, some land should be set aside in new communities, including land suitable for housing, streets, and so on.

I am sure that all of us have seen new suburbs distant from the central city built on very costly land with little tiny lots, many of them having soils unsuitable for housing, and with no more places for the children to play than in the tightly packed parts of the central city or its suburbs. The United States is very fortunate in having abundant soils for housing, for farming, for forestry, and for most other uses one can think of. We are a bit short of good soils with reasonable water supplies for subtropical crops.

Perhaps we could use more kinds of our soils at reasonable cost and with safety for houses and streets than we know now. This is an area of soil science with a big research gap. There are methods available for building very expensive structures on unstable soils. It seems reasonable to put large sums into foundations for these. But for ordinary houses of $15,000 to $75,000 we lack research experience on how to make stable foundations economically on a great many kinds of soil. In some ways I am not eager to push this research for fear that the results might lead to even more compact housing. Once an unsuitable soil is used for streets and light buildings, and they inevitably crack up, slide downhill, or wash away, it is both expensive and difficult to restore the soil to use for recreation or farming.

Recreation Facilities

The problem of setting land aside in one way or another to have nature study areas and playgrounds for young people is extremely critical. One hears a great deal about using soils for distant parks, wilderness areas, and so on. Such areas serve a recreational need. But our overwhelming need is for recreational and educational areas within walking distance of the homes of the children. I am not opposed to large public parks in distant areas for those who can afford to go there for a few weeks a year. But this need is minor in contrast to the nearly daily need of young people. I pass through hundreds of places in the central cities, and in the suburbs, where the children have only the streets for playgrounds. It is no wonder to me that we have a crime problem. It is no wonder to me that we have millions of people who have no outdoor manners--people who drop their rubbish in the handiest place for them. I know about this. I live in the suburbs and I have to police my garden almost daily; and it isn't all children's rubbish, unless they start drinking whisky and wearing size 12 shoes at an earlier age than formerly.

I see no way to meet this problem except by zoning and land-use regulations that are thoroughly understood by the citizens. In fact, people need more than simply to understand the regulations; they need to take part in their development. In most of the suburban areas around the big cities the problem could have been met by limiting industrial sites, streets, and residences to those soils that can be

made suitable for these purposes over a long period at reasonable cost. In some places this has been done by using soil maps. With housing limited to soils that can be used safely, the other areas are available for the young people to have places to play. Soils that are seasonably wet or occasionally flooded can be available as nature study areas most of the time. But they make very bad housing sites even if the wet period is only once in 10 years.

Soil Use in the Public Interest

Here we are in many ways one of the most advanced countries. (And we admit it!) We have abundant soil resources for all our uses. We have a wonderful transport system. We have enormous resources to develop electricity. We are said to have the most highly developed technology. We are said to have highly enlightened citizens. We are proud of our government. And yet we have gross inefficiencies in the use of our soil resources in farming and in the development of communities.

We use 50 million acres of unsuitable soils for cropping, even though we leave over 230 million acres of suitable soils for cropping mainly in brush, grass, or trees. We have enormous acreages suitable for housing. Yet we build potential slums on bad soils. We have vast areas suitable for recreation; yet we deny our young people playgrounds and nature-study areas they can walk to. Perhaps the division of powers under our Constitution complicates our problem. As you know, the Constitution of the United States does not give the Federal

government authority to make decisions about the use of private land. If an individual wants to plow up a soil unsuited for farming in order to grow crops, he may do so so far as the Federal government is concerned, except that under the general welfare clause he may be offered a payment for not doing it. This is an expensive procedure.

Responsibility for rural zoning and land-use regulations is the responsibility of State governments. They may do this directly, or more properly by delegation to counties and municipalities, which are beholden to the State government. Land-use regulations can be promulgated to achieve public purposes. Such purposes include provision for reasonable efficiency in the use and conservation of soil resources, protection of the public health against disease and pollution, education including outdoor education, and so on.

We also need to recognize that common law is an important force within our country. As I explained at some length in an address before this society at Logan (3), a man who violates the law has an opportunity for a jury trial and he will not be convicted of an act that seems reasonable to the reasonable men of the community. For this reason and because local citizens elect local officials, it is highly important that land-use regulations be studied and developed, with expert help, by the people in a county, township, or community. Research efforts, such as the Soil Survey, are obligated to give them the benefit of up-to-date research and experience on the kinds of soil

they have and to explain the alternatives and the outcomes to be expected on different uses of the different kinds of soil. But the decision should be made by the local people or their elected representatives.

Perhaps if this were done, it should not be necessary to pay farmers not to use unsuitable soils for farming or to pay local communities to set aside open space.

Thus, it seems to me that our legal systems are appropriate to meet these problems if there were understanding and reasonable determination to help one another, to have efficient soil use without waste, and to have good places for our children to grow up.

This is as far as I can go. In any public purpose there comes a time or place when natural science or social science, and the technology based on them, must give way to politics. These kinds of questions must become political issues. They must be debated in the Congress, in the State legislatures, and in the counties and communities. We can only do our part to help present the facts to enlighten the debate. But we have abundant soils to meet all our needs without waste or inefficiency and to provide our youth a good physical environment.